4.0 ENVIRONMENTAL CONSEQUENCES AND MITIGATION MEASURES

4.1 GEOLOGY AND SOILS

This section includes discussions of impacts and mitigation related to geologic and soil conditions likely to occur in the study area. Conditions that are unlikely to occur, such as landslides, subsidence, uplift, seiches, and tsunamis, are not discussed. In addition, there are no economic mineral resources in the study area; therefore, negligible impacts to mineral resources would occur. Because of the low potential for paleontological resources, impacts to these resources are unlikely to occur.

4.1.1 Topography

A. NO BUILD ALTERNATIVE

The No Build Alternative would not result in construction of new transportation facilities other than those addressed in previous environmental documents, therefore, no impacts to topography would occur.

B. TSM/EXPANDED BUS SERVICE ALTERNATIVE

The TSM/Expanded Bus Service Alternative would not result in construction of new transportation facilities that would alter topography. Therefore, negligible impacts, if any, to topography would occur.

C. FULL BUILD ALTERNATIVE

Existing topography consists of a freeway cross-section that consists of travel lanes and shoulders, with slopes beyond that to the existing Right of Way line. Along SR-22, proposed improvement would extend the freeway cross-section and the start of slopes an average distance of 18 feet on each side, with retaining walls of varying heights added where needed. All changes would be designed according to standard engineering practices and Caltrans specifications.

The Full Build Alternative would not appreciably change the topography within the study area. Fill or cut slopes would not exceed that necessary to allow grade separation at interchanges. In most cases, the only new fill required would be for widening of existing roadways or realignment of existing interchanges. In order to reduce right-of-way impacts, some of this fill would be retained with walls. The only portion of the Full Build Alternative with large cut slopes is a short distance east of the I-5 interchange. A minor amount of widening is proposed in this location with retaining walls.

The largest topographical change that would result under the Full Build Alternative is the new Pacific Electric Arterial and its interchange with SR-22. This new element would require structures and retained fill for the portion of the arterial/interchange that is elevated.

D. REDUCED BUILD ALTERNATIVE

The Reduced Build Alternative would not appreciably change the topography within the study area. Fill or cut slopes would not exceed that necessary to allow grade separation at interchanges. The only new fill required would be for widening of existing roadways or realignment of existing interchanges. In order to reduce right-of-way impacts, some fill would be retained with walls. Proposed improvements would extend the freeway cross-section and the start of slopes an average distance of 18 feet on each side, with retaining walls of varying heights added where

needed. Topographical changes would be minimal. All would be designed in accordance with standard engineering practices and Caltrans specifications.

***Thresholds of Significance for CEQA*:**

- Potential to alter the configuration of the ground surface including its relief and the position of its natural and man made features

A. NO BUILD ALTERNATIVE

The No Build Alternative would have no impact.

B. TSM/EXPANDED BUS SERVICE ALTERNATIVE

The TSM/Expanded Bus Service Alternative would have no impact.

C. FULL BUILD ALTERNATIVE

The Full Build Alternative would not appreciably alter the topography within the study area. The largest topographical change that would result under the Full Build Alternative is the new Pacific Electric Arterial and its interchange with SR-22. This new element would require structures and retained fill for the portion of the arterial/interchange that is elevated. However, since all changes would be designed according to standard engineering practices and Caltrans specifications, it would result in a less than significant impact.

D. REDUCED BUILD ALTERNATIVE

The Reduced Build Alternative would not appreciably alter the topography within the study area. New fill required would be mainly for widening of existing roadways or realignment of existing interchanges. In order to reduce right-of-way impacts, some fill would be retained with walls. Change to topography would be minimal. All changes would be designed in accordance with standard engineering practices and Caltrans specifications. These changes would result in less than significant impacts.

4.1.2 Seismicity

The study area may traverse the active Newport-Inglewood fault zone in the area of the I-405/SR-22 and I-405/I-605 interchanges, the exact location of which has not been identified. There are several seismic hazards that could affect this area, including ground acceleration or ground shaking, surface or fault rupture, and liquefaction (Section 4.1.3). These hazards could damage the structures and/or endanger human lives.

Ground shaking is what occurs at the earth's surface as a result of a release of energy during an earthquake. A vibrating or seismic wave generates from the source of the earthquake, much like the waves created when a rock is tossed into a pool of water. Generally, the closer the source is to the seismic event, the greater the ground shakes. Areas in close proximity to the I-405/SR-22 and I-405/I-605 interchanges would be most susceptible to the effects of ground shaking. Areas farther from this area would suffer less effect.

Surface rupture occurs when movement on a fault deep within the earth breaks through to the surface. Not all earthquakes result in surface rupture. Fault rupture almost always follows preexisting faults, which are zones of weakness. Rupture may occur suddenly during an earthquake or slowly in the form of fault creep. It is impossible to predict whether a surface rupture would occur during a seismic event in the Newport-Inglewood fault zone.

Other faults in the area could produce earthquakes that could damage the structures in the study area and result in injury or deaths. This condition is prevalent throughout California and is not unique to the study area.

A. NO BUILD ALTERNATIVE

The No Build Alternative would not result in construction of new transportation facilities other than those addressed in other environmental documents. Therefore, it would not pose potential additional seismic hazards beyond what currently exists in the study area.

B. TSM/EXPANDED BUS SERVICE ALTERNATIVE

The TSM/Expanded Bus Service Alternative would not include any capital improvements to SR-22. Therefore, it would not pose potential additional seismic hazards beyond what currently exists in the study area.

C. FULL BUILD ALTERNATIVE

The Full Build Alternative would include improvements in the assumed vicinity of the active Newport-Inglewood fault zone in the area of I-405/SR-22 and I-405/ I-605 interchanges. Thus, it would expose people to hazards described above. It should be noted, however, that the project would include only widening of an existing facility in this area; it would not expose people to a new hazard.

D. REDUCED BUILD ALTERNATIVE

The Reduced Build Alternative would include improvements in the assumed vicinity of the active Newport-Inglewood fault zone in the area of the I-405/SR-22 and I-405/ I-605 interchanges. Thus, it would expose people to hazards described above. It should be noted, however, that the project would include only widening of an existing facility in this area; it would not expose people to a new hazard.

Thresholds of Significance for CEQA:

- Potential for seismic hazards and ground shaking activities

A. NO BUILD ALTERNATIVE

The No Build Alternative would have no impacts to seismic hazards and ground shaking activities.

B. TSM/EXPANDED BUS SERVICE ALTERNATIVE

The TSM/Expanded Bus Service Alternative would have no impact to additional seismic hazards and ground shaking activities beyond what currently exists in the study area.

C. FULL BUILD ALTERNATIVE

The Full Build Alternative would include improvements in the assumed vicinity of the active Newport-Inglewood fault zone. It should be noted that the project would include only widening of an existing facility in this area; it would not expose people to a new hazard. This would result in less than significant impacts to seismic hazards and ground shaking activities.

D. REDUCED BUILD ALTERNATIVE

The Reduced Build Alternative would also include improvements in the assumed vicinity of the active Newport-Inglewood fault zone. This would result in less than significant impacts to seismic

hazards and ground shaking activities the proposed project involves widening of an existing facility.

4.1.3 Liquefaction

There is a moderate to high susceptibility to liquefaction within the study area due to a high water table. Adverse effects of liquefaction can take many forms, including flow failures, lateral spreads, ground oscillation, loss of bearing strength, settlement, and increased lateral pressure on retaining walls (EERI, 1994).

Flow failures are the most catastrophic ground failures caused by liquefaction. These failures commonly displace large masses of soil laterally, in some cases for great distances and at great speeds. Because these types of failures generally occur in steep slopes, however, they are unlikely to affect the project study area.

Lateral spreads involve lateral displacement of large, surficial blocks of soil as a result of liquefaction of a subsurface layer. Displacement occurs in response to the combination of gravitational forces and inertial forces generated by an earthquake. Lateral spreads generally develop on gentle slopes (most commonly less than three degrees) and move toward a free face such as an incised river channel. The displaced ground usually breaks up internally, causing the surface to break apart. Lateral spreads commonly disrupt foundations of structures, sever pipelines and other utilities, and compress or buckle roads and bridges. This type of failure is more likely within the study area.

Where the ground is flat or the slope is too gentle to allow lateral displacement, liquefaction at depth may decouple overlying soil layers from the underlying ground, allowing the upper soil to oscillate back and forth and up and down in the form of ground waves. Opening and closing of fissures and fracture of rigid structures such as pavements and pipelines usually accompany these oscillations. With the relatively flat topography of the study area, this is the most likely type of failure.

When the soil supporting a building or other structure liquefies and loses strength, large deformations can occur within the soil that may allow the structure to settle and tip. Conversely, buried tanks and piles may rise buoyantly through the liquefied soil. This is a secondary effect of liquefaction and there is a high potential for this type of failure in the study area.

In many cases, the weight of a structure will not be great enough to cause the large settlements associated with soil bearing capacity failures, described above. However, smaller settlements may occur as soil pore-water pressures dissipate and the soil consolidates after the earthquake. These settlements may be damaging, although they would tend to be much less so than the failures previously discussed. There is also a high potential for this type of failure within the study area.

Finally, if the soil behind a retaining wall liquefies, the lateral pressures on the wall may greatly increase. As a result, retaining walls may be laterally displaced, tilt, or structurally fail. Where retaining walls are planned within the study area, this condition should be considered.

A. NO BUILD ALTERNATIVE

Since no construction is associated with the No Build Alternative, aside from that discussed in previous environmental documents, no additional impacts related to liquefaction are anticipated.

B. TSM/EXPANDED BUS SERVICE ALTERNATIVE

The TSM/Expanded Bus Service Alternative would include operational improvements and would not include any capital improvements to SR-22. Therefore, new exposure to liquefaction hazards would be negligible.

C. FULL BUILD ALTERNATIVE

Structures and pavements associated with the Full Build Alternative would be susceptible to the types of failures discussed above, including lateral spreads, ground oscillation, loss of bearing strength, settlement, and increased lateral pressure on retaining walls.

D. REDUCED BUILD ALTERNATIVE

Structures and pavements associated with the Reduced Build Alternative would be susceptible to the types of failures discussed above, including lateral spreads, ground oscillation, loss of bearing strength, settlement, and increased lateral pressure on retaining walls. The exposure to these hazards would be less than under the Full Build Alternative.

Thresholds of Significance for CEQA:

- Potential for liquefaction activities

NO BUILD ALTERNATIVE

A. The No Build Alternative would not result in significant impacts related to liquefaction.

B. TSM/EXPANDED BUS SERVICE ALTERNATIVE

The TSM/Expanded Bus Service Alternative would not result in significant impacts on new exposure to liquefaction hazards.

C. FULL BUILD ALTERNATIVE

Structures and pavements associated with the Full Build Alternative would be susceptible to the types of failures discussed above, including lateral spreads, ground oscillation, loss of bearing strength, settlement, and increased lateral pressure on retaining walls. The Full Build Alternative soil would be stabilized to minimize the potential for liquefaction or to control its effect, resulting in less than significant impacts.

D. REDUCED BUILD ALTERNATIVE

The Reduced Build Alternative would also be subject to the types of failures discussed under the Full Build. The exposure to these hazards would be less than under the Full Build Alternative, resulting in less than significant impacts.

4.1.4 Expansive Soils

Expansive soils contain clay minerals, which will swell when wetted to as much as 1.5 or 2.0 times their original dry volume. The saturation of soil from rainfall, irrigation, groundwater, or leaking pipes may cause major damage through the expansion of soils beneath highways, utility lines, and foundations. If construction takes place on wet materials that have high shrink-swell potential, and these materials subsequently are drained and dried, the resulting shrinkage may cause severe cracking in structures.

Expansive soils are found throughout the study area.

A. NO BUILD ALTERNATIVE

Because no construction is associated with the No Build Alternative, aside from that discussed in previous environmental documents, no additional impacts related to expansive soils are anticipated.

B. TSM/EXPANDED BUS SERVICE ALTERNATIVE

The TSM/Expanded Bus Service Alternative would not include any capital improvements to SR-22. Therefore, new failures associated with expansive soils as described above would not be of concern.

C. FULL BUILD ALTERNATIVE

Structures and pavements associated with the Full Build Alternative would be subject to the failures associated with expansive soils described above, unless appropriate measures are taken.

D. REDUCED BUILD ALTERNATIVE

Structures and pavements associated with the Reduced Build Alternative would be subject to the failures associated with expansive soils described above, unless appropriate measures are taken. The exposure to these hazards would be less than under the Full Build Alternative.

Thresholds of Significance for CEQA:

- Potential for expansive soils

A. NO BUILD ALTERNATIVE

No impacts related to expansive soils are anticipated as a result of the No Build Alternative.

B. TSM/EXPANDED BUS SERVICE ALTERNATIVE

The TSM/Expanded Bus Service Alternative would not result in significant impacts related to expansive soils.

C. FULL BUILD ALTERNATIVE

Structures and pavements associated with the Full Build Alternative would be subject to the failures associated with expansive soils described above, unless appropriate measures are taken. These may include replacement of soil, treatment with lime, or supporting of structures on deep foundation, which would take place during the construction phase. Appropriate measures taken would result in less than significant impacts related to expansive soils for the Full Build Alternative.

D. REDUCED BUILD ALTERNATIVE

Structures and pavements associated with the Reduced Build Alternative would be subject to the failures associated with expansive soils described above, unless appropriate measures are taken. The exposure to these hazards would be less than under the Full Build Alternative, also resulting in less than significant impact.

4.1.5 Erosion

A. NO BUILD ALTERNATIVE

Since no construction is associated with the No Build Alternative, aside from that discussed in previous environmental documents, no additional impacts related to erosion are anticipated.

B. TSM/EXPANDED BUS SERVICE ALTERNATIVE

Only operational improvements and minor construction is included in the TSM/Expanded Bus Service Alternative; therefore, negligible impacts related to erosion are anticipated.

C. FULL BUILD ALTERNATIVE

The Full Build Alternative would require the disturbance of soil and sediments in upland areas and in riverbeds during construction. Grading would occur in upland areas and new piers would be installed in riverbeds. Consequently, the potential exists for disturbed soil to erode and for sediments to be transported by water.

D. REDUCED BUILD ALTERNATIVE

The Reduced Build Alternative would require the disturbance of soil and sediments in upland areas and in riverbeds during construction. Grading would occur in upland areas and new piers would be installed in riverbeds. Consequently, the potential exists for disturbed soil to erode and for sediments to be transported by water.

Thresholds of Significance for CEQA:

- The potential for disturbance of soil causing erosion, disturbance of soil in riverbeds, soil erosion during excavation, and the redesigning of drainage which may result in slope erosion

A. NO BUILD ALTERNATIVE

No additional impacts related to the above erosions are anticipated under the No Build Alternative.

B. TSM/EXPANDED BUS SERVICE ALTERNATIVE

No impacts related to the above-discussed erosions are anticipated with this alternative.

C. FULL BUILD ALTERNATIVE

The Full Build Alternative would result in less than significant impacts if appropriate erosion-control measures are taken.

D. REDUCED BUILD ALTERNATIVE

The Reduced Build Alternative would result in less than significant impacts if appropriate erosion-control measures are taken.

4.1.6 Mitigation

A. NO BUILD ALTERNATIVE

None proposed.

B. TSM/EXPANDED BUS SERVICE ALTERNATIVE

None proposed.

C. FULL BUILD ALTERNATIVE

GEO-FB-1. Structures will be designed to resist the maximum credible earthquake associated with nearby faults without endangering human life through collapse. To minimize potential structural damage due to seismically induced ground shaking, the following design measures will be utilized as needed:

- Hinge restrainers to hold together superstructure elements during extreme motion
- Heavy keys to limit movement between the superstructure and abutment
- Increased reinforcement in column sections to assure effective confinement of concrete allowing large movements to occur without collapse

GEO-FB-2. Detailed geotechnical studies will be performed for areas that will support pavement or foundations in conjunction with detailed engineering design to provide appropriate boring, soil, and fault information. This information will be used to minimize potential adverse impacts. The following items will be addressed:

- Precise location of areas of potential liquefaction
- Borings to determine the depth and geometry of alluvium and deeper soil types and to sample materials for various laboratory analyses
- Establishment of engineering criteria for ground acceleration to be used for the design of corridor structures and facilities in accordance with Caltrans guidelines

All areas of historically high or perched groundwater levels will be analyzed in detail during project design to verify the potential for liquefaction. Should soils subject to liquefaction be found, site-specific engineering techniques (e.g. importation of stable material, compaction of soils, permanent dewatering, and attachment of deep-set piles to bedrock or lower denser soils) will be implemented.

GEO-FB-3. Small structures will be strengthened to resist predicted ground movements.

GEO-FB-4. Appropriate foundation types and depths will be designed (including foundation modifications in the case of existing structures), so that the ground movements will not adversely affect the structure. For example, deep piles or piers that extend below the zone of liquefiable soil may be used.

GEO-FB-5. Soil will be stabilized to eliminate the potential for liquefaction or to control its effects (e.g., removal and replacement of liquefiable soils; in-situ stabilization by grouting, densification, or dewatering; buttressing of lateral spread zones).

GEO-FB-6. During final engineering design, the area and thickness of expansive soils will be evaluated. Measures that mitigate for expansive soils will be incorporated into the construction documents. These measures may include replacement of soil, treatment with lime, or supporting of structures on deep foundations.

GEO-FB-7. Appropriate erosion-control measures will be incorporated into the construction documents and implemented during site preparation, grading, and construction. These measures may include protecting exposed slope areas, control of surface flows over exposed soils, use of wetting or sealing agents and/or sedimentation ponds, and limiting soil excavation in high winds. (See also HYD-FB-2 in Section 4.2.4)

GEO-FB-8. Excess excavated soil will be hauled away from the job site, and disposed of at an appropriate permitted disposal facility.

GEO-FB-9. To avoid transport of sediments during construction, work within riverbeds will not occur when water is present. If necessary, cofferdams may be used to keep water out of the construction area.

GEO-FB-10. Roadway and bridge deck drainage will outlet under the bridge abutments onto energy dissipaters to prevent slope erosion.

D. REDUCED BUILD ALTERNATIVE

Mitigation measures GEO-RB-1 through GEO-RB-10 are the same as those for the Full Build Alternative, discussed above.

4.1.7 Residual Impacts after Mitigation

A. NO BUILD ALTERNATIVE

None.

B. TSM/EXPANDED BUS SERVICE ALTERNATIVE

None.

C. FULL BUILD ALTERNATIVE

Through mitigation, impacts related to liquefaction and expansive soils would be prevented. All other impacts would be minimal after mitigation.

D. REDUCED BUILD ALTERNATIVE

Through mitigation, impacts related to liquefaction and expansive soils would be prevented. All other impacts would be minimal after mitigation.